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MARINE MICROORGANISMS AS A SOURCE OF NEW ANTIBIOTICS

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Abstract
Infections in animals, including humans, are caused by microorganisms. Antimicrobial drugs are typically used to treat infections. These antimicrobial substances can originate from microbes, plants, and animals. Antimicrobial agents, sometimes known as antibiotics, are produced in large part by microorganisms. Antibiotics can be synthetic, natural, or semi-synthetic substances. Microorganisms produce natural antibiotics. Nearly two-thirds of all known antibiotics with a microbial origin come from actinomycetes. More than 6000 molecules are produced by Streptomyces species, some of which are significant pharmaceuticals that are traded on the market and utilized as immunosuppressive, anti-infective, or anti-cancer medications. Numerous physiologically active metabolites can be produced by bacteria. Some of them may be insecticides, herbicides, or enzymes like xylanase and cellulase, while others are antibiotics. Numerous industries make use of them. Antibiotics are the most widely used of these substances in medicine and have significant economic value. Numerous industries, including medicines, animal husbandry, and agriculture, have made use of antibiotics. Scientists around the world have been actively pursuing the screening of microbes for the development of antibiotics for decades.
Keywords: clinical applications, Marine, Microorganisms, New Antibiotics.

1. INTRODUCTION

The use of antimicrobial drugs in the treatment of infectious diseases has to be one of the biggest achievements of medicine this century. Fleming's discovery of penicillin in 1928 was rediscovered [1] as a chemotherapeutic. Waksman began using actinomycetes that were isolated from soil to screen for antibacterial chemicals in 1928. He found actinomycins, some of which are employed as anticancer medicines. All bacterial illnesses appeared to have been eradicated with the development of several therapeutically effective antibiotics, including erythromycin, streptomycin, chloramphenicol, chlortetracycline, neomycin, and oxytetracycline. However, some species of Staphylococcus, Mycobacterium, and Gram-negative enteric bacteria had become resistant to antibiotics within ten years of the widespread use of antibiotic therapy [9]. The pharmaceutical industry has done a fair job of controlling issues with single resistance determinants over the past 20 years [13]. However, the emergence of diverse resistance mechanisms has severely limited the practical use of many important medication classes. Although resistance to any new antimicrobial medication will inevitably develop and spread, new antibiotic classes with unique mechanisms of action will provide effective treatment for a while. Marine microorganisms are a complex and varied group of microscopic living things that may be found in all seas, even in those with extremely high or low salinity, temperature, and pressure. In addition to ensuring life in a wide

variety of harsh settings, marine microorganisms have evolved distinctive metabolic and physiological traits that provide the possibility of metabolite creation that is invisible to land-based germs[2]. The discovery led to early suggestions that marine bacteria could be a source of biomedically active chemicals. It has been discovered that marine microorganisms can produce novel natural compounds that are not present in terrestrial sources; most of these chemicals exhibit biological activity, including antibiotic properties [11]. In general, nothing is known about marine bacterial distributions. Seawater is full in gram-negative species like Vibrio. The remainder are gram-positive bacteria that belong to a variety of taxonomic groups, including the genus Bacillus[3]. The inside chambers of invertebrate animals, sediments, and inanimate and alive surfaces are the other noteworthy microhabitats of marine bacteria. It is commonly known that many microbes have developed symbiotic partnerships with marine plants and animals. This is especially true for bacteria, which are widely found in the tissue and on the surface of marine plants and animals. Since numerous chemicals identified from sponges, ascidians, and other marine invertebrates may actually be produced via bacterial symbiosis, its significance is becoming increasingly apparent [4].

2. REVIEW OF LITERATURE

Krasilnikova (1961) has reported antibiotic activity of microorganisms from various ocean depths of the globe. Buck et al. (1962) studied anti-yeast bacteria from the sea. Arima et al. (1964) have obtained Pyrrolnitrin, a novel antibiotic compound from Pseudomonas. Doggett (1968) have isolated a novel anti-Pseudomonas agent from a marine [15]. Gauthier (1976a) isolated Alteromonas rubra sp. now, a novel marine antibiotic producing bacterium. Gandhi et al. (1976) isolated predigiosin from a marine Pseudomonas sp. Ballester et al. (1977) have isolated a high molecular weight antibiotic from a marine bacterium. Wratten et al. (1977) have shown that marine Pseudomonas sp. yield antibiotic metabolites. Gjessing and Ruskin (1977) have studied antibiotic activity of bacteria of some Caribbean sponges. Lakshmanaperumalsamy (1978) has worked on actinomycetes in the context of antagonistic streptomycetes of Porto Novo sediments. Gauthier and Breittnayer (1979) have isolated a new bacterium producing an antibiotic from sea water. Alteromonas aurantia sp. Nov. Okami et al. (1980) have shown the production of a new enzyme glucanase of marine Bacillus. Polyketides, terpenes, polysaccharides (like acarbose), polyethers, and nitrogen-containing compounds (including indoles, peptides, pyrroles, and glycopeptides) are only a few of the many different kinds of chemical structure that microorganisms provide. Bioactive compounds are provided by marine bacterial taxa as Streptomycetes, Pseudoalteromonas, Cytophaga, Alteromonas, Micrococcus, Bacillus, A cinetobacter, Agrobacterium, and Pseudomonas (Dobler et al., 2002) [6].

3. MATERIALS AND METHODS

Molecular biological techniques have also been used to use bacteria to create novel flavanones and dihydroflavonols, as well as drug-like isoprenoid chemicals that were initially identified from plants. Numerous developments in organic chemistry have been spurred by natural products, leading to improvements in synthetic techniques and the potential to create analogues of the original lead chemical with better pharmacological or medicinal action. Throughout history, there have been numerous instances where a natural product has served as both a medication and a means of exposing a previously unknown aspect of physiology. Natural product extracts might be employed as natural product extracts or simply as soon as possible in the screening campaign to try to give more time to follow up on probable hits. With traditional small molecule libraries, this might be expanded beyond the high throughput method on strategically significant targets that do not yield hits. Numerous naturally occurring chemical scaffolds, including alkaloids, terpenoids, flavonoids, and steroids, have been subjected to combinatorial methods [7].

The identification of antibacterial medications such as penicillins, cephalosporins, aminoglycosides, tetracyclines, and polyketides has been considerably aided by the discovery of bioactive complexly structured chemicals found in terrestrial microbes. Microorganism metabolites have recently been used therapeutically as immunosuppressive drugs (like cyclosporins and rapamycin), cholesterol-lowering drugs (like lovastatin and mevastatin), antihelmintic drugs (like ivermectin), antidiabetic drugs (like acarbose), and anticancer drugs[5].

Humanity is constantly searching for new medicine sources due to the growing number of people on the planet, the emergence of new diseases, and the rise in bacterial resistance. The list has expanded over the last ten years to include additional targets that provide difficulties to humanity, such as AIDS, immunosuppression, anti-inflammation, Alzheimer disease, aging processes, and several tropical diseases. Early drug development was based on naturally occurring medications used therapeutically from microorganisms and terrestrial creatures. Since ancient times, people have utilized natural products—organic chemicals made by microorganisms and plants—for a variety of purposes, including food, fragrances, coloring, pesticides, and medications. It has long been regarded as an exceptional source of potent medicinal medication because of its greater chemical variety compared to other natural goods. It includes thousands of mixed biosynthetic chemicals and a vast array of chemical classes with different structures, including terpenes, shikimates, polyketides, acetogenins, peptides, and alkaloids.

4. RESULT AND DISCUSSION

In the marine ecosystem, food and space competition is great and hence the marine forms have specialized structures, metabolic patterns, reproductive system, sensory, and defense mechanisms as a result of adaptation to unfriendly environment ranging from cold polar seas to the enormous pressures of ocean floor. Aquaculture has developed into a significant industry to capture the humongous turnover of bio-energy for human beings. As aquaculture relies on renewable natural resources, it has unlimited future for the next several hundred years. Aquaculture is also being considered as the sole alternative to increase fish production because of the over exploitation of natural fish resources. Over the past 10 years, aquaculture has emerged as the food production method with the quickest rate of growth worldwide. Aquaculture production rose from 7.4 million tonnes in 1980 to over 42 million tonnes in 1999, with a total value of over US$53 million. Sector production is increasing at an average of more than 10% per year versus a 3% increase in production of meat from land animals and 1.5% increase in capture fishery production. Over 30% of human-consumed food is provided by aquaculture in 1997 (GESAMP Reports and Studies, 2001). Global estimates of future supplies from aquaculture production are 47 million tonnes in 2010. But with this staggering global growth have come problems of success, particularly lethal animal diseases. For instance, intensive production shrimp cultivation has experienced booms and busts since its inception 25 years ago. South America and Asian nations including Taiwan, Thailand, Indonesia, and Ecuador produce almost all of the world's farm shrimp. However, in the 1980s and early 1990s, anticancer drugs and virus infections occurred in almost every nation with sizable shrimp farming operations.

Increasing human populations, the emergent diseases and increasing bacterial resistances have led the mankind towards discovering ever-fresh sources of drug leads. Recent targets that are causing problems for humanity, such as AIDS, immunosuppression, anti-inflammation, Alzheimer disease, aging processes, and several tropical diseases, are being added to the stock list[8]. The therapeutic natural products present in soil plants and microorganisms have been the basis for drug development in the initial years[14]. Natural products are organic substances synthesized by organisms like microbes and plants that have been used by humans for centuries for various uses such as food, perfumes, dyes, insecticides and medicines. Such natural compounds have long been acknowledged as a rich source of medicinally active substances since their chemical uniqueness surpasses that of all other sources. It encompasses a broad range of chemical classes, including peptides, alkaloids, polyketides, acetogenins, terpenes, shikimates, and a variety of mixed biosynthesis products [12].

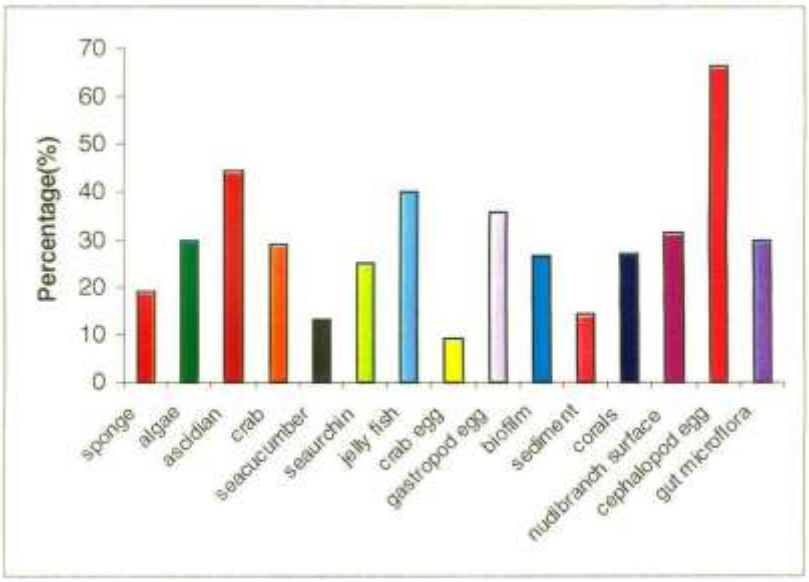

Figure 1: Percentage occurrence of antibiotic producers in the marine sources

Marine animals, especially sedentary ones such as macroalgae, sponges, ascidians, bryozoans and their associated microorganisms, synthesizing a variety of bioactive metabolites to compete for space, to prevent fouling by other foulers from their surface and for predation avoidance, are the potential source of new drug leads and have been intensely targeted.

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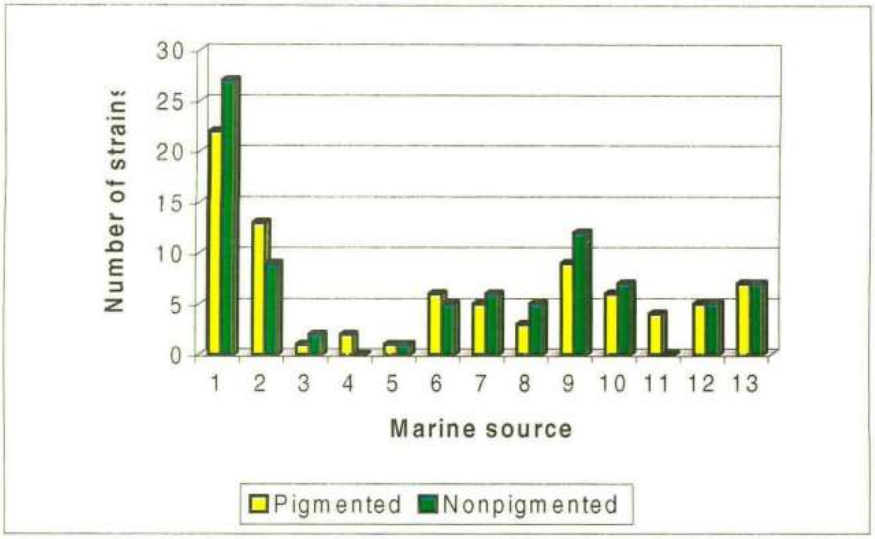

Fig 2. Total number of pigmented and nonpigmented antibiotic producing bacteria from different marine sources

These chemical compounds have an important role in the connection of living organisms and their environment and chemical communication in water are of vital significance to organism's behaviour and reproduction especially settlement of spores and larvae. Ocean is therefore regarded as a vast pool of resources and bound to be a rich reservoir of new natural products for many decades to come.

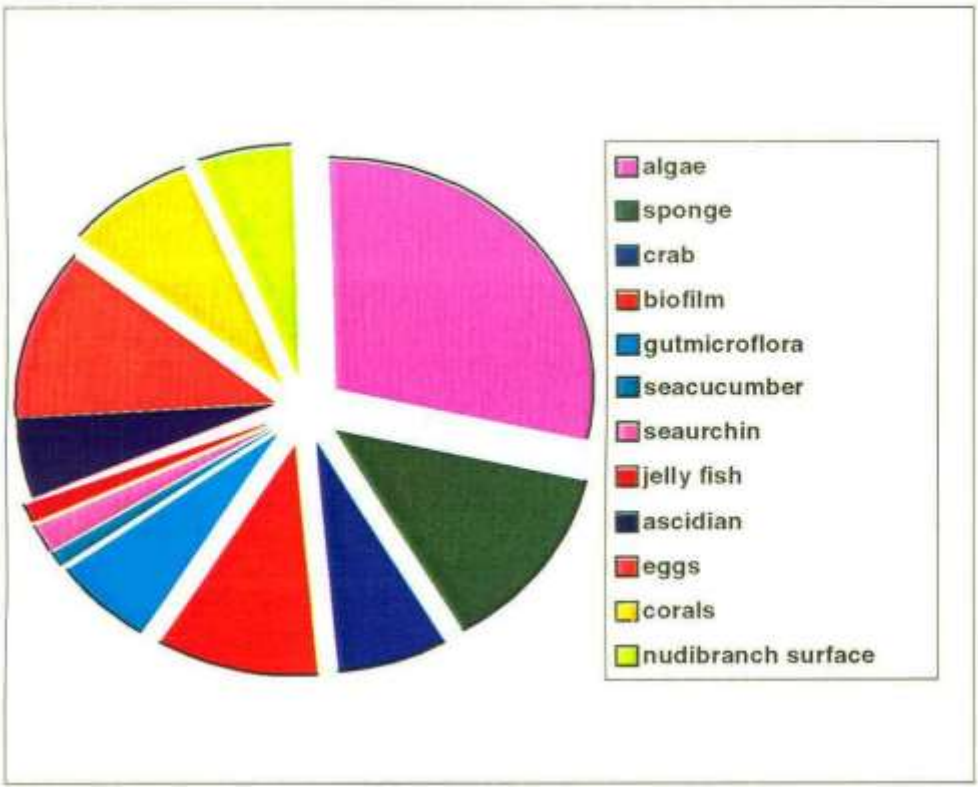

Figure 3: Total number of pigmented and nonpigmented antibiotic producing bacteria from different marine sources

Numerous bloactive chemicals, which are linked to saltwater, sediments, algae, and marine animals, were extracted from Streptomyces, Altermonas/Pseudoalteromonas, Bacillus, Vibrio, Pseudomonas, and Cytophaga. They produce trace levels of quinones, polyenes, macrolides, alkaloids, peptides, and terpenoids. Extremophiles like acidophiles, alkalophilis, halophiles, baro, thermophiles and psycrophiles have become increasingly popular among researchers in recent times. The enormity of the microbial diversity in the world's oceans as the preliminary findings indicate is itself a promising area for the discovery of new drugs, even though their taxonomy is poorly defined.

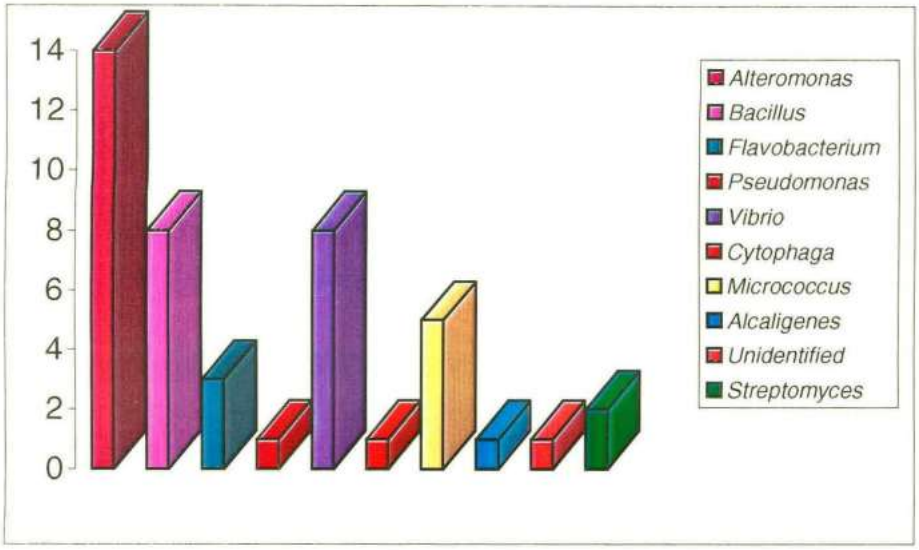

Fig 5. Genus level representation of potential marine bacteria producing antibiotics against human pathogens

Thus, the aim of the work was to isolate the suspected bioactive involved bacterial strains from the marine habitats, grow them by optimizing the growth and biosynthesis of the bioactive metabolites, screen against human pathogenic bacteria, detect the strains of high efficacy by molecular analysis, identify pharmacological property, and purify and structure determine the active metabolite.

5. CONCLUSION

Natural products are the secondary or non-primary metabolites of living things. Natural products have been used by man for thousands of years for different purposes such as food, perfumes, pigments, insecticides and medicines. Marine organisms, especially sedentary ones produce secondary metabolites of diverse ecological significance, most of which have been discovered to show biomedical significance. Marine microbes are generally in the range of 103-106 per milliliter, up to 109 per milliliter in marine sediments and less than 5 percent have been so far cultured and identified. Bacteria control organic matter mineralization rates, nutrient cycling and energy transfer rates in aquatic ecosystems. Microbial competition for space and nutrients in the ocean leads to the production of natural products of industrial and medicinal importance.

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